

Charge-Coupled Amplifier and Converter with

Matched Offsets

Application is a continuation of Provisional application NO. 60/089,330 filed on 06/15/98.

Background and Summary of the Invention

5 The present invention relates to integrated image sensor circuits, and more particularly to active integrator pixel architectures with on-board digital converters.

Background: Active Integrator Pixel Architectures

10 The active integrator-per-pixel architecture is an effective technique for implementing high speed, high sensitivity linear optical arrays with analog outputs. An example of this architecture is found in the TSL1301 102x1 Linear Sensor Array with Hold, manufactured by Texas Instruments. (This integrated circuit and its data sheets are all hereby incorporated by reference.) The sensor array architecture is a key element in obtaining the desired speeds and sensitivities, and
15 has been described in detail in prior commonly owned applications: TI-23302 - Ser.No. 09/002,731, filed January 1, 1998; TI-23303 - Ser.No. 09/002,904, filed January 1, 1998; and TI-24772 - Ser.No. 09/002,639, filed January 1, 1998); all of which are hereby incorporated by reference. A feature of the
20 TSL1301 architecture is that charges representative of the integrated photocurrent of each pixel are stored on capacitors. Current integrated over time defines a charge, so the pixel readout signals initially appear as a variable charge. Since this charge appears on a capacitor, it can be read out as a voltage which is referenced to chip ground; but there

voltage node Va, and switch Sc is connected to ground. Switch S1 is connected to the SUM node and the voltage Va settles to a value which is then digitized. The precharge and evaluation phases continue for all subsequent inputs S2...Sn.

5 Other features and details which are also contemplated for use in the preferred embodiments, but which are not necessary for practice of the claimed inventions, are disclosed in the following co-pending applications:

Att'y docket number TI-27352P, Ser. No. 09/333,850 - Optical Sensor Array With Zone-Programmable Gain and Offset"; and

Att'y docket number TI-27353P, Ser. No. 09/334,205 - "Addressing and Communication for Multiple-Chip Optical Sensor Arrays".

Both of these are commonly owned with the present application, and have effective filing dates which are simultaneous with that of the present application, and are herein incorporated by reference.

Alternative Embodiment: No Extra Switch and Capacitor

Figure 1B shows an alternative embodiment of the circuit of Figure 1A. In this embodiment, switch Sc and capacitor Cos are not used. To start a conversion cycle, switch Sa is put in the upper position, contact VrefHi, and switch Sb is closed. This precharges capacitor Cint to VrefHi. Next, switch Sb is then opened, switch Sa is switched to the lower position to contact Va, and concurrently switch S1 is connected to the SUM node. Assuming non-overlapping switches, the voltage Va on the output of amplifying element A1 will settle to the voltage $V_a = V_{refHi} - (V_1 * C_1) / C_{int}$. Voltage Va is then

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